Office of the Registrar
FORM 40G REV. 9/06

PURDUE UNIVERSITY

REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF A GRADUATE COURSE
(500-600 LEVEL)

Print Form

DEPARTMENT Mechanical Engineering

EFFECTIVE SESSION Spring 2017

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [X] 1. New course with supporting documents (complete proposal form)
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	ME	Subject Abbreviation	
Course Number	65000	Course Number	
Long Title	Computational Fracture Mechanics		
Short Title			

Abbreviated title will be entered by the Office of the Registrar if omitted. (22 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Summer [ ] Fall [X] Spring

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [ ] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range: Minimum Cr. Hrs
(Check One) To [ ] Or [ ]
Maximum Cr. Hrs.
3. Equivalent Credit: Yes [ ] No [ ]
4. Thesis Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Designator Required [ ]
6. Special Fees [ ]
7. Registration Approval Type
Department [ ] Instructor [ ]
8. Variable Title [ ]
9. Remedial [ ]
10. Honors [ ]
11. Full Time Privilege [ ]
12. Off Campus Experience [ ]

Instructional Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated	Delivery Method (Asyn. Or Syn.)	Delivery Medium (Audio, Internet, Live, Text-Based, Video)
Lecture	50	3	16	100		
Recitation						
Presentation						
Laboratory						
Lab Prep						
Studio						
Distance						
Clinic						
Experiential						
Research						
Ind. Study						
Pract/Observ						

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES):

Calumet Department Head	Date	Calumet School Dean	Date	Calumet Undergrad Curriculum Committee	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date	Fort Wayne Chancellor	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date	Undergrad Curriculum Committee	Date
North Central Department Head	Date	North Central Chancellor	Date	Date Approved by Graduate Council	
West Lafayette Department Head Amit Bajaj / QPQ	4/25/16	West Lafayette College/School Dean	10/21/16	Graduate Council Secretary	Date
Graduate Area Committee Convener	4/29/16	Graduate Dean	Date	West Lafayette Registrar	Date

OFFICE OF THE REGISTRAR

Engineering Faculty Document No. 6-17

TO: The Faculty of the School of Mechanical Engineering

FROM: Thomas Siegmund

DATE: April 15, 2016

RE: New Course, ME 65000 Computational Fracture Mechanics

The Faculty of the School of Mechanical Engineering has approved the following new course offering. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ME 65000 COMPUTATIONAL FRACTURE MECHANICS
Sem. 2. Class 3, cr. 3 (el.) (Offered in alternate years.)
Prerequisite: graduate student standing

Course Description: Advanced concepts of methods for the analysis of cracks, of crack propagation and damage evolution. Prediction of the macroscopic behavior of structures as it emerges from the presence of defects such as cracks, voids, or delamination. Linear elastic and nonlinear fracture problems. Rate independent and rate dependent problems. Methods in computational fracture mechanics where material separation emerges as an outcome of the boundary value problem. Demonstrations of how mechanical design can take advantage of the methods of computational fracture mechanics by introducing such concepts into structural analyses. Applications of computations in predictive analysis and its importance in simulation-based engineering.

Reason: This course has been offered several times on an experimental basis, each time with a substantive an enrollment both on campus and online via Engineering Professional Education. (Spring 2008: developed course, enrollment 14; Spring 2010: enrollment 13 on campus, and 6 on-line; Spring 2012: enrollment 15 on campus, and 13 on-line. Spring 2016: current enrollment 14). Many domains of mechanical, aerospace, civil and nuclear engineering require practicing engineers to be able to assess the risk to failure. Such assessment is invariable conducted with computational mechanics methods. If students do not acquire competency in this process, engineering solutions will continue to be based largely on traditional methods of tables and handbooks. These basic tools do not allow one to consider effects of material nonlinearity, and do also not consider complex loading scenarios. The performance of many engineering products is, however, increasingly linked to material nonlinearity and complex geometries. Only mechanical engineers with a sound background and training in the relevant engineering mechanics background will be able to handle these issues.

James D. Jones
Associate Professor and Associate Head, School of Mechanical Engineering

Approved for the faculty of the Schools of Engineering by the Engineering Curriculum Committee
ECC Minutes #3 Date 10-18-16
Chairman ECC

ME 65000
COMPUTATIONAL FRACTURE MECHANICS

Course Outcomes

1. Introduce concepts of *computational methods for material damage, fracture and fatigue*
2. Learn *continuum mechanics* concepts for description of material failure
3. Learn about advanced *constitutive equations* for bulk and interface failure
4. Learn how *model* material failure processes
5. Learn how to develop and apply *computational mechanics methods*
6. Apply these concepts to *analysis of failure the macro, micro and nano scale*

Fundamentals (3 wks)

1. Review of Continuum Mechanics Concepts
2. Review of Finite Element Method
3. Linear Elastic Fracture Mechanics
4. Elastic-Plastic Fracture Mechanics
5. Fatigue Crack Growth
6. Damage Mechanics

Ductile Fracture (4 wks)

1. Von Mises Plasticity
2. Damage Indicator
3. Gurson Model
4. Tensile test
5. Crack Growth, Constraint Effects
6. Length Scales
7. J-Integral
8. CTOA and CTOD
9. Dissipation Rate
10. Material Forces
11. Applications

Cohesive Zone Models (4 wks)

1. Cohesive Zone Model
2. Delaminations
3. Material Parameters – Experiments and Models
4. Heterogeneous Fracture Properties
5. Elastic-plastic Fracture
6. Metal Matrix Composites
7. Nano-Composites
8. 3D Modeling Aspects
9. Advanced Cohesive Zone Models

Fatigue Crack Growth (4 wks)

1. Continuum Models for Fatigue Failure
2. Cohesive Zone Models for Fatigue
3. Fatigue in Ceramics, Composites, and Adhesives
4. Metal Fatigue
5. Interfaces

To: Purdue University Graduate Council

From: Faculty Member: James Jones

Department: Mechanical Engineering

Campus: West Lafayette

Date: 4/18/16

For Reviewer's comments only
Select One
Reviewer:
Comments:

Subject: Proposal for New Graduate Course-Documents Supporting Registrar's Form 40

Contact information if questions arise

Name: James Jones

Phone Number : 765-494-5691

E-mail: jonesjd@purdue.edu

Campus Address: 585 Purdue Mall Room 2200

Course Number: ME 65000

Course Title: Computational Fracture Mechanics

A. Justification for the Course

☒ Explain how this course relates to other courses offered in the department or other departments and how this course fulfills a recognized need.

☒ This course is intended primarily for students Choose one: from within this department

B. Level of the course:

☒ Justify request for graduate course level by indicating anticipated enrollments of undergraduate and graduate students.

Anticipated Undergraduate Student Enrollment: 0-10%

Anticipated Graduate Student Enrollment: 75-100%

C. **Prerequisites**: (If none, please explain reasons for absence)

☒

D. **Course Instructor**:

☒ Instructor's Name Thomas Siegmund

E1. **Course Outline**:

☒ (An outline of topics to be covered and an indication of the relative emphasis or time devoted to each topic is necessary. If laboratory or field experience is involved, the nature of this component should be explained as well).

E2. ☒ Method of Evaluation or Assessment:

F. **Reading List:**

☒ A reading list or bibliography should be limited to material the students will be required to read in order to successfully complete the course. It should not be a compilation of general reference material.